ELITE Program

Electric Insertion Transfer Experiment

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CRDA

- 1986 Federal Technology Transfer Act- make US industry more competitive

- ELITE CRDA signed by AF & TRW 1991, & ratified by Gen. Rankine, AFSC/XT Jan 92

- AF Provides major subsystems
  - Arcjet, photovoltaic arrays, diagnostics
  - Launch vehicle, ground segment, s/c & lv integration

- TRW provides spacecraft
  - Spacecraft, systems engineering. & flight support
  - Flight software, launch & missions operations support

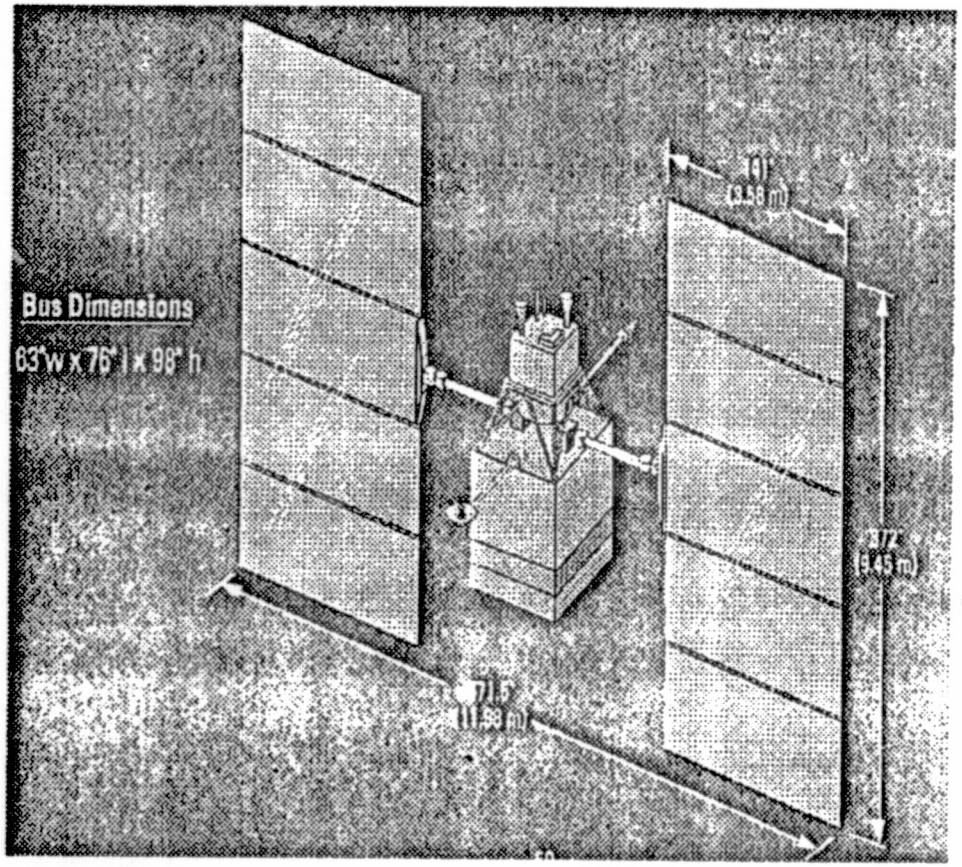
Concept

- O OBJECTIVE
  - System level demonstration of Electric Orbit Transfer Vehicle (EOTV) adequate to establish LEO to GEO transfer capability, orbit maneuvers

- O DESCRIPTION
  - Demonstrate EOTV system
    - o Autonomous orbit transfer
    - o Orbit repositioning
    - o Survivability in Van Allen belts
  - Demonstrate critical subsystems
    - o Arcjet
    - o Solar array
    - o Autonomous GN&C

Electric Insertion Transfer Experiment

O Electric orbit transfer vehicle (EOTV) and reposition demonstration



Deployed ELITE Spacecraft

- Validate LEO-GEO EOTV transfer
- Demonstrate rapid orbit reposition
- High power arcjet and photovoltaic arrays
- Autonomous GN&C

O Experiment
- 10kW NH3 arcjet, photovoltaic array
- 200 to 2150 nmi alt.
- 63.5 to 60.5 deg inclination
- 45 day transfer
- Total radiation flux = LEO-GEO transfer
- 100 deg reposition at 2150 nmi, 6 days

O Operational System
- 30kW H2 arcjet, photovoltaic array
- 200 to 20,000 nmi alt.
- 28.5 to 0 deg inclination
- 6 month transfer
- Total radiation flux = LEO-GEO transfer
- Orbit reposition at GEO

EOTV
New Space Business

- Faster or more on-orbit maneuvers
- Increase MLV capability to HLV range
- Expand HLV capability to NLS domain
- Fast crisis response GEO satellites
  - Launch-On-Schedule & on-orbit spares
- 2x the payload & 1/2 trip time of ballistic asteroid, comet missions
- High power platform for space tests

Program Milestones

• Program start,	*Jan 91*
• Go/No Go,	Dec 91
• Systems Requirements Review,	Sep 92
• Go/No Go,	Dec 92
• Preliminary Design Review,	Jul 93
• Critical Design Review,	Jun 94
• Flight Qualification Review,	Mar 96
• Launch,	*Sep 96*
• Flight Op.s end,	Jun 97

Subsystem Status

- **Ammonia arcjet**
  - RFP release end Nov 92
  - 1460 continuous hours demonstrated, 50% x needed
  - 707 on/off cycles demonstrated, 30% x needed
  - At 10 kW, Isp > 620 s, efficiency > 33%
- **Photovoltaic array**
  - RFP release end Nov 92
  - BOL= 10.2 kW, EOL>= 6.8 kW
  - Sp power >= 40W/kg
- **Diagnostics**
  - Prioritized
  - Health & status, engineering & scientific data

Subsystem Status

Cont.'d

- **High Power Testbed**
  - Objective: Simulate ELITE power distribution system with arcjet load
  - Approach: Solar array simulator, peak pwr tracking, pwr distribution system, arcjet
  - Rationale: Eliminate risks of end-to-end system
  - Testing: Nov 92 at PL/Edwards AFB
- **Spacecraft Bus (TRW UTB)**
  - Modular, improved performance, reduced weight, reduced cost
  - ELITE adaptations include structure, thermal control, avionics

Partners

- Other government & industry partners likely

Organization	Bus	Propul	P/V	Diag	GN&C	Experiment	Cost
TRW	X				X		
Air Force		X	X	X			
NASA Code R			X			Xe Ion, hydrogen arcjet	
NASA Cose S							X
AFSPACECOM							X
General Dynamics			X			Cryo H2 storage	

Payloads

- Global Surv Sat Tech Demo, Eagle Dancer (PL)
  - New, 5-10kW, maneuvering?, #1 AFSPACECOM
- High Temperature Superconductivity Space Experiment (NRL)
  - Needs bus, operate in Van Allen belts, #2 Tri Service SERB
- High power ELITE spacecraft bus (JPL)
  - Candidate for Discovery program
  - The body for EP planetary spacecraft
  - 2x payload mass in 1/2 time to comets, asteroids
- High power ion engine experiment (JPL/LeRC)
  - Qualify engine for VESTA/CLIPPER
- Radiation Hardened S/C Microelectronics (NRL & PL)
  - Van Allen belt exposure? #6 AFSPACECOM
- Space Surveillance Initiative (PL)
  - New, maneuvering need? #9 AFSPACECOM
- Hydrogen arcjet and cryo storage (Gen Dynamics, LeRC)
  - Experiment or primary propulsion

Summary

- ELITE system demo traceable to operational solar electric vehicle
- CRDA assures transfer of advanced technology to industry
- Orbit transfer, maneuvering, planetary vehicles greatly reduce the cost of future missions
- ELITE & CRDA offers opportunity benefiting DOD, NASA and industry interests